Remarks

Claims 1-24 are being presented for reconsideration, with claims 1, 14, and 23 being the independent claims. Claim 24 is sought to be added. Claims 1-4, 6-7, 9-14, and 23 have been amended. Applicant reserves the right to prosecute similar or broader claims, with respect to the amended claims, in the future. No new matter has been introduced by any amendments.

Based on the above amendments and following remarks, Applicant respectfully requests that the Examiner reconsider all outstanding rejections and that they be withdrawn.

Rejections under 35 U.S.C. §§ 102(e)

Claims 1-23 were rejected under 35 U.S.C. §102(e) as allegedly being anticipated by U.S. Publication No. 2004/0071817 to Fischer et al. ("Fischer"). Applicant traverses this rejection.

Applicants traverse this rejection because Fischer is not proper prior art to this application. Neither the subject matter in Figures 14-16 or the related text of Fischer, which were relied upon by the Examiner to reject claims 1-23, were included in U.S. Provisional Patent Application 60/399,621 to which Fischer claims benefit. (Copy attached hereto as Exhibit A). Thus, the constructive reduction to practice date for this embodiment of Fischer is the filing date of U.S. Appl. 10/629,699, which was July 30, 2003. This date is after the effective filing date of the instant application. The effective filing date of the instant application is December 9, 2002, which is the filing date of U.S. Provisional Patent Application 60/431,714 ("the '714 application") from which the instant application claims priority. The instant claims are fully supported in the '714 application. Thus, Applicant "swears behind" the Fischer reference. Accordingly, Applicant respectfully asserts that this rejection should be reconsidered and withdrawn, and claims 1-23 should be found allowable over this reference.

Rejections under 35 U.S.C. §§ 102(b)

Claims 1-6, 9, 10, 13-15, and 18-23 were rejected under 35 U.S.C. §102(b) as allegedly being anticipated by U.S. Patent No. 6,309,208 to Kazmer ("Kazmer"). Applicant traverses these rejections.

Claim 1

Claim 1 distinguishes over Kazmer. For example, claim 1 recites: a nozzle body including a first threaded portion on an outside surface ...a tip surrounding piece having a second threaded portion on an inside surface, such that the tip surrounding piece is removably connected with respect to said nozzle body through mating of the first and second threaded portions.

Kazmer does not teach or suggest this feature. For example, in Figures 5a-5c and 30 of Kazmer, and related text, Kazmer teaches threads on an outside surface of element 39 and an inside surface of element 23. Therefore, Kazmer does not anticipate claim 1.

Accordingly, Applicant respectfully requests that the Examiner reconsider and withdraw the rejection of claim 1 over Kazmer. Also, at least based on its dependency from claim 1, claim 24 should be found allowable over Kazmer.

Claim 14

Claim 14 distinguishes over Kazmer. For example, claim 14 recites: a nozzle body... including a bore having a same bore diameter along its length...a tip having a first portion with a same first portion diameter along its length, wherein that the first portion diameter is substantially the same as the bore diameter so that the first portion is received within the bore.

Kazmer does not teach or suggest this feature. For example, in Figures 5a-5c and 30 of Kazmer, and related text, element 37 has first and second diameters for respective first and second portions of element 37, as does the bore in element 23. Therefore, Kazmer does not anticipate claim 14.

Accordingly, Applicant respectfully requests that the Examiner reconsider and withdraw the rejection of claim 14 over Kazmer. Also, at least based on their respective dependency to claim 14, claims 15 and 18-22 should be found allowable over Kazmer.

Claim 23

Claim 23 distinguishes over Kazmer. For example, claim 23 recites: a tip surrounding piece removably connected with respect to said nozzle body, wherein said tip surrounding piece is free of contact with said tip, and wherein said tip surrounding piece and said tip are spaced from each other by a gap.

Kazmer does not teach or suggest this feature. For example, in Figures 5a-5c and 30 of Kazmer, and related text, at least a top portion of element 39 touches a bottom portion of element 37, apparently to support element 37. Therefore, Kazmer does not anticipate claim 23.

Accordingly, Applicant respectfully requests that the Examiner reconsider and withdraw the rejection of claim 23 over Kazmer. Also, at least based on their dependency to claim 23, claims 2-6, 9-10, and 13 should be found allowable over Kazmer.

Conclusion

All of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Applicant therefore respectfully requests that the Examiner reconsider all presently outstanding rejections and that they be withdrawn. Applicant believes that a full and complete reply has been made to the outstanding Office Action and, as such, the present application is in condition for allowance. If the Examiner believes, for any reason, that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at the number provided.

Prompt and favorable consideration of this Amendment and Reply is respectfully requested.

Respectfully submitted,

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Exhibit A

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BERESKIN & PARR **UNITED STATES**

Title: A VALVE PIN GUIDING AND ALIGNMENT SYSTEM FOR AN INJECTION MOLDING MACHINE

Inventor(s): Jonathon Fischer
Denis Babin

Title: A VALVE PIN GUIDING AND ALIGNMENT SYSTEM FOR AN INJECTION MOLDING MACHINE

FIELD OF THE INVENTION

This invention relates to an injection molding machine, and more particularly to a valve pin guiding and alignment system for a valve pin on an injection molding machine.

BACKGROUND OF THE INVENTION

In many injection molding operations, there is a need to utilize a movable valve pin to open and close a gate into a mold cavity in order to control the melt flow into the mold cavity. There is a well known problem that the valve pin may become misaligned with the gate at some mold cavities on an injection molding machine. This misalignment can occur for many reasons. For example, the nozzle in which the valve pin moves may not be perfectly aligned with the gate. Thermal expansion and contraction of the components of the injection molding machine, which takes place repeatedly during an injection molding campaign can cause components to shift, ultimately resulting in misalignment of the nozzle and valve pin with the gate. Non-homogeneity in the melt itself can cause the melt to exert uneven fluid pressure on the valve pin body, which can push the end of the valve pin out of alignment with the gate.

When a misaligned valve pin is moved to close a gate, the valve pin collides with the gate and can cause scoring of the sealing surfaces on the valve pin and/or the gate. This can ultimately result in poor quality parts with blemishes around the gate, and can cause other problems with the molding operation. Furthermore, a damaged valve pin or gate can be expensive and time consuming to replace.

There is a continuing need for new systems for aligning the valve pin with respect to the gate, to reduce the likelihood of damage caused by misalignment.

SUMMARY OF THE INVENTION

In a first aspect the invention is directed to an injection molding machine, including at least one plate, at least one nozzle, a mold plate, first

and second guide surfaces and first and second alignment surfaces. The at least one plate defines at least one runner. The runner has an inlet for receiving melt from a melt source. Each nozzle defines a nozzle melt channel, wherein the nozzle melt channel is in fluid communication with the at least one runner. The mold plate defines at least one mold cavity, wherein a gate into the mold cavity is included in the mold plate, the at least one mold cavity is in fluid communication with the at least one nozzle by means of the gate, and the gate includes a gate sealing surface. The valve pin is movable in the nozzle, into and out of the gate to close and open the gate. The valve pin includes a valve pin sealing surface that is adapted to engage the gate sealing surface to inhibit melt flow therepast. The first guide surface is positioned on the valve pin. The second guide surface is positioned on at least one of the nozzle, the mold plate and a structure that is connected at least indirectly to the mold plate. The second guide surface is adapted to engage the first guide surface when the valve pin is misaligned with respect to the gate, and the first and second guide surfaces are adapted to cause the valve pin to slide into alignment with the gate as the valve pin is moved towards the gate. The first alignment surface is positioned on the valve pin. The second alignment surface is positioned on at least one of the nozzle, the mold plate and a structure that is connected at least indirectly to the mold plate. After the first and second guide surfaces cooperate to align the valve pin with respect to the gate the first and second alignment surfaces are adapted to cooperate with each other, to maintain the valve pin in alignment with the gate as the valve pin is moved towards the gate, wherein the first and second alignment surfaces are separate from the sealing surfaces on the gate and the valve pin.

DESCRIPTION OF THE DRAWINGS

For a better understanding of the present invention and to show more clearly how it may be carried into effect, reference will now be made by way of example to the accompanying drawings, in which:

Figure 1 is a sectional view of an injection molding machine having a plurality of valve pin guiding and alignment systems in accordance with the prior art;

Figures 2a, 2b, 2c and 2d are magnified sectional side views showing the operation of a valve pin and mold plate of the prior art;

Figure 3 is a sectional view of an injection molding machine having a plurality of valve pin guiding and alignment systems in accordance with a first embodiment of the present invention;

Figures 4a, 4b, 4c and 4d are magnified sectional side views of the valve pin guiding and alignment system shown in Figure 3;

Figure 5 is a magnified sectional side view of a valve pin guiding and alignment system in accordance with an alternative embodiment of the present invention;

Figure 6 is a sectional side view of a portion of the injection molding machine shown in Figure 3, including a misaligned valve pin and the valve pin guiding and alignment system shown in Figures 4a–4d, showing the valve pin in an open position with respect to a gate into a mold cavity;

Figure 7 is a sectional side view of the injection molding machine portion shown in Figure 6 illustrating first contact by the valve pin with a portion of the guiding and alignment system;

Figure 8 is a sectional side view of the injection molding machine portion shown in Figure 6, illustrating the valve pin in a closed position with respect to the gate;

Figure 9 is a sectional side view of a portion of the injection molding machine, showing an optional relief channel that may be included in the valve pin guiding and alignment system;

Figure 10 is a sectional side view of a portion of an injection molding machine showing a misaligned valve pin and a valve pin guiding and alignment system in accordance with another alternative embodiment of the present invention, whereby the valve pin is in an open position with respect to a gate into a mold cavity;

Figure 11 is a sectional side view of the injection molding machine portion shown in Figure 10, illustrating first contact between the valve pin and a portion of the valve pin guiding and alignment system;

Figure 12 is a sectional side view of the injection molding machine portion shown in Figure 10, illustrating when the valve pin first contacts another portion of the valve pin guiding and alignment system;

Figure 13 is a sectional side view of the injection molding machine portion shown in Figure 10, illustrating the valve pin in a closed position with respect to the gate; and

Figure 14 is a sectional side view of a portion of an injection molding machine showing a variant of the valve pin guiding and alignment system shown in Figures 6, 7 and 8.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Reference is made to Figure 1, which shows an injection molding machine 10 of the prior art. The injection molding machine 10 includes one or more runners 12, that transfer melt from an inlet 14 to one or more nozzles 16. The runners 12 are defined within one or more molding machine plates, such as, for example, a manifold 18.

The nozzles 16 transfer melt from the runners 12 through one or more gates 20 and into one or more mold cavities 22 defined in a mold plate 24. Each nozzle 16 may be heated by a heater 25. Each nozzle 16 defines a nozzle melt channel 26 which is in fluid communication with a runner 12 and thus, with the melt source.

A valve pin 28 is movable within each nozzle melt channel 26 to open and close one of the gates 20, permitting or restricting the flow of melt into the mold cavity 22. The configuration of the end portion of the valve pin 28 and the gate 20 and their engagement are shown in more detail in Figures 2a, 2b, 2c and 2d. The valve pin 28 typically includes a generally cylindrical body 30, a cylindrical sealing surface 31, which is typically on the endmost portion of the body 30, and an end face 32. The edge between the end face 32 and the sealing surface 31 is shown at 34 and is typically chamfered to facilitate the introduction of the valve pin 28 into the gate 20.

Due to the fact that the end face 32 and chamfered edge 34 will ultimately make up a portion of the surface of the mold cavity 22, there may be design restrictions on the angle of the chamfered edge 34. For example, the chamfered edge 34 may be limited to having a relatively shallow angle with respect to the end face 32 so as to provide a certain shape in the molded part.

The gate 20 typically includes a cylindrical sealing surface 36 adjacent the mold cavity 22, and also includes a chamfered inlet surface 38. The sealing surface 36 receives and cooperates with the sealing surface 31 of the valve pin 28 to seal the gate 20 against melt flow into the mold cavity 22. The chamfered inlet surface 38 cooperates with the chamfered edge 34 on the valve pin 28 to facilitate the introduction of the valve pin 28 into the gate 20.

The movement of the valve pin 28 will now be described. In Figure 2a, the valve pin 28 is shown spaced from the gate 20. The valve pin 28 may be misaligned with the gate 20 to any degree. When the valve pin 28 is moved to close the gate 20, if there is any misalignment of the valve pin 28 and gate 20, the valve pin 28 first contacts the gate 20 in the manner shown in Figure 2b. The first contact is made by the chamfered edge 34 and the chamfered inlet surface 38. As the valve pin 28 moves forward to close the gate 20, the chamfered edge 34 slides off the chamfered inlet surface 38 thereby guiding the valve pin 28 into alignment with the gate 20. The valve pin 28 then moves forwardly in the sealing surface 36 of the gate 20, as shown in Figure 2c until arriving at the 'closed' position, as shown in Figure 2d. It will be appreciated that the 'closed' position of the valve pin 28 need not be as shown in Figure 2d. After a number of molding cycles, the repeated contact between the valve pin 28 and the inlet surface 36 of the gate 20 can eventually result in one or both of the sealing surface 31 of the valve pin 28 and the sealing surface 36 of the gate 20 being scored, worn away or otherwise damaged.

The portions of the valve pin 28 and the gate 20 that can be damaged are shown at 39a and 39b respectively. This damage can result in melt leaking past the gate 20 after the gate 20 is closed, and can also result in blemishes on the molded part. Thus, depending on the needs of the molding operation, the valve pin 28 and the gate 20 may require repair or replacement. It will be noted that the scoring or damage shown at 39a and 39b can occur almost immediately, depending on the nature of the molding operation, and thus poor quality parts can result virtually immediately. This problem is exacerbated if the angle of the chamfered edge 34 on the valve pin 28 is shallow, because the contact forces between the valve pin 28 and the gate inlet surface 38 can further promote wear, scoring or other damage.

Reference is made to Figure 3, which shows an injection molding machine 40, in accordance with a first embodiment of the present invention. The injection molding machine 40 may be any suitable type of injection injection molding machine, and may be similar to the injection molding machine 10, except that the injection molding machine 40 includes a valve pin 42 and a guiding and alignment system 44. The valve pin guiding and alignment system 44 prolongs the life of the valve pin 42 and gate 20 by reducing or eliminating contact between the valve pin 42 and gate 20 during closure of the gate 20.

Reference is made to Figures 4a, 4b, 4c and 4d, which show the configuration of the end portion of valve pin 42, the valve pin guiding and alignment system 44 and the gate 20. The valve pin 42 includes a body 46, a sealing surface 48, an end face 50 and a first guiding and alignment structure 52. The body 46 may have any suitable shape, such as generally cylindrical. The sealing surface 48 may be similar to the sealing surface 31 on the valve pin 28 in Figures 2a – 2d, and cooperates with the sealing surface 36 to close the gate 20.

The first guiding and alignment structure 52 is positioned between the body 46 and the sealing surface 48, and includes a first tapered guide surface 54 and a first alignment surface 56. The first tapered guide surface 54 and first alignment surface 56 cooperate with a second tapered guide surface 58 and a second alignment surface 60 on a second guiding and alignment structure 62, to bring the valve pin 42 into alignment with the gate 20.

As the valve pin 42 moves from the position shown in Figure 4a towards the gate 20, if there is any misalignment between the valve pin 42 and the gate 20, the first contact made occurs between the first and second guide surfaces 54 and 58, as shown in Figure 4b. The first and second guide surfaces 54 and 58 may be provided with any selected angle of taper. Thus, the taper angles, which are shown at $\Theta 1$ and $\Theta 2$ respectively, can be selected to reduce the risk of scoring or otherwise damaging one or both guide surfaces 54 and 58 upon first contact or upon any subsequent sliding contact.

It will be noted that the guide surfaces 54 and 58 and the alignment surfaces 56 and 60 on the first and second structures 52 and 62 have a larger diameter than the surfaces 36, 38, 34 and 31 on the gate 20 and valve pin 28

of Figures 2a-2d. By having the contact and sliding occur on these larger diameter surfaces 54, 58, 56 and 60, the first and second structures 52 and 62 are adapted to have a longer service life before requiring repair or replacement, relative to the smaller diameter surfaces 36, 38, 34 and 31 of Figures 2a-2d.

One or both of the first and second guide surfaces 54 and 58 may be hardened by any suitable surface treatment means, to further reduce the risk of scoring. One of the first and second guide surfaces 54 and 58 may be selected to be harder than the other, so that the softer of the two may be 'sacrificed' during the repeated contacting and sliding that occurs during an injection molding campaign. The surface 54 or 58 that is selected to be sacrificed may be, for example, on the part that is the less expensive of the two, the easier of the two or the less time consuming of the two to replace.

As the valve pin 42 is moved towards the gate 20, the first and second guide surfaces 54 and 58 cooperate to bring the valve pin 42 into alignment with the gate 20. Once the first guide surface 54 is moved past the second guide surface 58, the first and second alignment surfaces 56 and 60 contact each other to maintain the valve pin 42 in alignment with the gate 20. The valve pin 42 is then moved towards and into the gate 20, to close the gate 20, as shown in Figure 4d.

The first and second alignment surfaces 56 and 60 may be surface treated in a similar way to the first and second guide surfaces 54 and 58, and may also include one surface 56 or 60 that is selected to be sacrificial.

It will be noted that, because the valve pin 42 is aligned with the gate 20 before entering the gate 20, a chamfered edge is not required between the end face 50 and the sealing portion 48. By not chamfering the edge, it is possible to virtually eliminate any blemishes on the molded part, by moving the valve pin 42 into the gate 20 so that the end face 50 is flush with the interior surface of the mold cavity 22.

Nonetheless, a chamfered edge may be included optionally, and is shown at 61. The chamfered edge 61 may, however, have any suitable shape as desired to meet the aesthetic requirements of the molded part, with no effect on the ability of the valve pin 42 to enter and close the gate 20.

The portions of the components shown in Figures 4a – 4d, that incur wear and damage are shown at 64a and 64b, and are positioned away from the sealing surfaces 48 and 36. Thus, by incorporating the first and second guiding and alignment structures 52 and 62, the service life of the valve pin 42 may be extended beyond the service life of the valve pin 28. Furthermore, since damage from misalignment is reduced or eliminated, blemishes that occur on the molded parts as a result of the damage are reduced or eliminated.

Together, the first and second guiding and alignment structures 52 and 62 make up the valve pin guiding and alignment system 44. It has been shown for the first and second guiding and alignment structures 52 and 62 to be integrally incorporated into the valve pin 42 and the mold plate 24, the structures 52 and 62 may be made as separate pieces, which may be joined to the valve pin 42 and mold plate 24 by any suitable means. For example, referring to Figure 5, the first structure 52 may be made as a ring that includes a threaded portion 66, which mates with a corresponding threaded portion 68 on the valve pin 42. By making the structure 52 as a separate piece that is removable from the valve pin 42, the structure 52 may more easily be made from any suitable material having any desired mechanical properties. The structure 52 may be made to be hard and to resist wear, or alternatively, the structure 52 may be made to be soft, if, for example, the structure 52 is selected to be sacrificial, as described above. The first structure may also include a tool engaging surface 69 for installation and removal of the first structure 52 from the valve pin 42.

In a similar fashion to the structure 52, the structure 62 may be made as a separate piece, such as a ring and may be made to be removably connectable to the mold plate 24 by means of mating threaded portions 70 and 72 on the structure 62 and the mold plate 24 respectively. The second structure may also include a raised tool engaging surface 73 for installation and removal of the second structure 62 from the mold plate 24. As a separate, removably attachable piece, the mechanical properties of the second structure 62 may be selected as desired.

Referring to the embodiments shown in all the Figures, the second structure 62 must be positioned far enough away from the gate 20, so that the

valve pin 42 is aligned by the cooperation of the first and second guide surfaces 54 and 58 before any portion of the valve pin 42 contacts the gate 20. With deference to the condition above, it is however advantageous for the second structure 62 to be positioned as close as possible to the gate 20, to reduce the risk of the end of the valve pin 42 becoming misaligned again after being aligned by the second structure 62. Such misalignment can occur again, for example, due to non-homogeneity in the melt downstream from the second structure 62.

It is particularly preferable that the tolerances used in the manufacture or machining of the first and second alignment surfaces 56 and 60 are generally similar or tighter than the tolerances used in the manufacture of the gate sealing surface 36 and the valve pin sealing surface 48. If the tolerances on the alignment surfaces 56 and 60 were significantly looser than those on the sealing surfaces 36 and 48, then it would be possible that the alignment surfaces 56 and 60 would not ensure that the valve pin 42 is aligned with the gate 20, and thus the valve pin 42 would be permitted to slightly contact the inlet surface 38, thereby risking slight damage to the inlet surface 38 and the sealing surfaces 36 and 48.

Reference is made to Figure 6, which shows a portion of the injection molding machine 40 that includes an optional gate insert 74, that is positioned in the mold plate 24. In this embodiment, the second structure 62 and the gate 20 are included in the gate insert 74, instead of being directly included in the mold plate 24. Also in this embodiment, the valve pin 42 includes an optional relief channel 76 that extends longitudinally along a portion of the body 46. The function of the relief channel is explained further below.

In the position shown in Figure 6, the valve pin 42 is spaced from the gate 20. Referring to Figure 7, as the valve pin 42 is moved towards the gate 20, if the valve pin 42 is misaligned with respect to the gate 20, the first contact made by the valve pin 42 is between the first guide surface 54 and the second guide surface 58. The valve pin 42 is guided by the cooperation between the first and second guide surfaces 54 and 58, into alignment, and the alignment is maintained by the first and second alignment surfaces 56 and 60, until the valve pin 42 closes the gate 20, as shown in Figure 8.

As the valve pin 42 approaches the position shown in Figure 8, the relief channel 76 that is included in the first alignment surface 56 provides a path for the melt that is displaced by the end of the valve pin 42 itself as it moves towards closing the gate 20.

Referring to Figure 9, it is alternatively possible for the second alignment surface 60 to include a relief channel 78 instead of the relief channel 76 on the valve pin 42.

Reference is made to Figure 10, which shows the valve pin guiding and alignment system 44, further comprising optional third and fourth guiding and alignment structures 80 and 87, which cooperate to further align the valve pin 42 with respect to the gate 20.

The third guiding and alignment structure 80 positioned on the valve body 46, upstream from the first structure 52. The term upstream is used in relation to the direction of the melt flow through the nozzle 16. The third structure 80 may be similar to the first structure 52 except that the third structure 80 has a generally larger diameter than the first structure 52. The third structure 80 includes a third guide surface 84 and a third alignment surface 86.

The fourth structure 87 may be similar to the second structure 62 and may include a fourth guide surface 88 and a fourth alignment surface 90. The fourth structure 87 may be positioned anywhere suitable, such as on the discharge end of the nozzle 16. In this embodiment, the nozzle 16 may include a separate nozzle tip 92, as shown in Figure 10, or alternatively, the nozzle tip 92 may be integrally formed with the nozzle 16.

It is particularly preferable in the embodiment shown in Figure 10, for the nozzle 16 or at least the nozzle tip 92 to be aligned generally with the gate 20 so that the third and fourth structures 80 and 87 cooperate with the first and second structures 52 and 62 to provide improved alignment of the valve pin 42.

The third and fourth structures 80 and 87 may be integrally included on the valve pin 42 and the nozzle tip 92, as shown in Figure 10, or one or both may be separate from the valve pin 42 and the nozzle tip 92, and may be removably attached thereto.

As shown in Figure 11, if the valve pin 42 is misaligned, the first contact by the valve pin 42 occurs on the guide surface 88 of the fourth structure 87. The guide surface 88 may be angled with a relatively slow taper, to reduce pressure losses in the melt flow through the nozzle tip 92. Care must be taken to ensure that the third and fourth guide surfaces 84 and 88 cooperate to ensure that other surfaces of the valve pin 42 such as the sealing surface 48, do not contact the nozzle tip 92.

After the valve pin 42 is aligned by the cooperation of the third and fourth alignment surfaces 86 and 90, the valve pin 42 next contacts the first and second structures 52 and 62, as shown in Figure 12. The alignment surfaces 56 and 60 cooperate with the alignment surfaces 86 and 90 so that that the valve pin 42 enters the gate 20 relatively straight and not at an angle with respect to the axis of the gate 20, as shown in Figure 13. This further reduces the risk of scoring or otherwise damaging the sealing surfaces 36 and 48 on the valve pin 42 and the gate 20.

Reference is made to Figure 14, which shows another alternative embodiment of the guiding and alignment system 44, whereby the second structure 62 is included either integrally or removably on the nozzle tip 92, instead of being included on the mold plate 24 or the gate insert 74. The first structure 52 would be positioned appropriately on the valve pin 42 to cooperate with the second structure 62 in this embodiment.

A particular example of an injection molding machine is shown in the Figures. It will be appreciated that the injection molding machine may be any suitable type of injection molding machine, and may have more or fewer mold cavities. Furthermore, each mold cavity may be provided with more than one gate. Also, more than one material may be transferred simultaneously through the injection molding machine and into each mold cavity, for example, when making molded articles that have multiple layers of different materials.

While the above description constitutes the preferred embodiments, it will be appreciated that the present invention is susceptible to modification and change without departing from the fair meaning of the accompanying claims.

CLAIMS

1. An injection molding machine, comprising:

at least one plate, said at least one plate defining at least one runner, said runner having an inlet for receiving melt from a melt source;

at least one nozzle, each said nozzle defining a nozzle melt channel, wherein said nozzle melt channel is in fluid communication with said at least one runner;

a mold plate defining at least one mold cavity, wherein a gate into said mold cavity is included in said mold plate, wherein said at least one mold cavity is in fluid communication with said at least one nozzle by means of said gate, and said gate includes a gate sealing surface;

a valve pin that is movable in said nozzle, into and out of said gate to close and open said gate, said valve pin including a valve pin sealing surface that is adapted to engage the gate sealing surface to inhibit melt flow therepast;

a first guide surface that is positioned on said valve pin;

a second guide surface that is positioned on at least one of said nozzle, said mold plate and a structure that is connected at least indirectly to said mold plate, wherein said second guide surface is adapted to engage said first guide surface when said valve pin is misaligned with respect to said gate, and said first and second guide surfaces are adapted to cause said valve pin to slide into alignment with said gate as said valve pin is moved towards said gate;

a first alignment surface that is positioned on said valve pin; and

a second alignment surface that is positioned on at least one of said nozzle, said mold plate and a structure that is connected at least indirectly to said mold plate, wherein after said first and second guide surfaces cooperate to align said valve pin with respect to said gate said first and second alignment surfaces are adapted to cooperate with each other, to maintain said valve pin in alignment with said gate as said valve pin is moved towards said gate, wherein said first and second alignment surfaces are separate from said sealing surfaces on said gate and said valve pin.

2. A method of guiding a valve pin for an injection molding machine into engagement with a gate of said molding machine comprising:

providing a first guide surface on said valve pin adjacent to but upstream from the sealing surface of said pin and a second guide surface on said molding machine adjacent to but upstream from said gate;

providing a first alignment surface on said valve pin adjacent to but upstream from the sealing surface of said pin and a second alignment surface on said molding machine adjacent to but upstream from said gate; and

guiding said valve pin as said pin moves downstream to close said gate by interaction of said first and second guiding surfaces and interaction of said first and second alignment surfaces before said pin closes said gate.